DESCRIPTION

LOWER ALCOHOL ACTIVATED WITH PLOUGH CATALYST AND FUEL ADDITIVE COMPRISING THE SAME

TECHNICAL FIELD

The present invention relates to a method of activating a lower alcohol which comprises bringing the lower alcohol with a substance activated by heating and pressurizing in the presence of wood vinegar and/or bamboo vinegar or with a material formed by processing the substance, and a lower alcohol activated by the method. The present invention also relates to a lower alcohol containg the activated lower alcohol and to a fuel additive comprising the one or more lower alcohols. The present invention is further related to a fuel composition containing a fuel and the fuel additive.

BACKGROUND ART

The 20th century was the age when the Western civilization was advanced, and that material science and market economy were developed. As a result, the rhythm of nature has gradually become out of order, and thereby destruction of nature such as air pollution, rivers and seas pollution, acidification of soil by acid rain and global warming has been caused in many places. On the other hand, as everyone knows, unplanned use of chemical fertilizers and agricultural chemicals for farm crops has made soil inorganic and chemical materials have remained in soil.

As the result, the ability of soil to supply nutrition to farm crops has been lost year by year. Further, nitric acid remaining in soil and the hazardous substances contained in agricultural chemicals are adsorbed by farm crops; and it is believed that nitric acid undesirably taken into the human body becomes a factor generating active oxygen and that the residual hazardous substances from the agricultural chemicals causes no small disorder of the body.

In particular, widespread use of the internal-combustion engines that consume fossil fuels such as gasoline has increased the amount of carbon dioxide discharged into the atmosphere, and large amount of nitrogen oxides and sulfur oxides as well as organic fine particles (HC) have been discharged into the atmosphere, which represents one of the major causes of air pollution. Thus, internal-combustion engines using alcohol or natural gases instead of fossil fuels and electric cars etc. working by fuel cells have been developed but are not yet in widespread use because of the unsatisfactory power and acceleration performance thereof.

The present inventor has made inventions concerning reduction of the pollution caused by fuels such as gasoline (WO 98/428072. and U.S. Patent No. 5980700). These inventions relate to methods of treating fuel oils by feeding the fuel oils such as gasoline through a magnetic field, then treating the fuel oils with ultrasonic wave and further feeding the fuels oils through an electric field in the presence of a particular inorganic substance such as tourmaline stone, and relate to

apparatuses for the treatments. The inventor has shown that it is possible to reduce the amounts of CO_2, NOx and SOx in exhaust gases and also the emissions of hydrocarbon fine particles and thus to obtain fuel oils abating pollution by these treatments, although the detailed reasons are still unknown.

It is a fact that these treatments have extraordinary effect, although the detailed mechanism of the methods has not yet become clear.

Further, Hatanaka et al. disclosed a method of converting water into activated hard water by feeding a pressurized water through a layer of an inorganic substance such as ceramic, metal piece, ferromagnetic mineral, or the like and then aerating the treated water (Japanese Patent Application Laid-Open (JP-A) No. 3-106494). They found that minerals in inorganic substance are dissolved and further the amount of dissolved oxygen is increased by the aeration, by treating water in this manner, and thereby water having suppression of development of microorganisms such as E. coli can be obtained. However, it does not mention about the applicability thereof to fuel.

The inventors have filed a patent application concerning a method of activating a substance heating and pressurizing the material in the presence of wood vinegar and/or bamboo vinegar, and an activated material (called plough catalyst) which is produced by the method (Japanese Patent Application No. 2002-348151). They have also filed a patent application concerning a concrete board (called eco-board) using such an activated substance (Japanese Patent Application No.

2002-348152).

Prior arts related to the present patent application are as follows:

1. WO 98/42807
2. U.S. Patent No. 5980700
3. Japanese Patent Application Laid-Open (JP-A) No. 3-106494
4. Japanese Patent Application No. 2002-348151
5. Japanese Patent Application No. 2002-348152

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide a fuel additive that can inhibit the emission of harmful gases from a fuel such as gasoline, light oil, and the like, without adversely influencing the consumption of the fuel and with which the fuel can be stably stored, and a fuel composition containing the fuel additive added thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a top view of an apparatus for production of the plough catalyst according to the present invention.

Figure 2 shows a cross-sectional view of the apparatus for producing the plough catalyst according to the present invention.

EXPLANATION OF NUMERALS

1 Apparatus for producing the plough catalyst according to the present invention

2 Cap

3 Cap-locking handle

4 O-ring seal

5 Pressurized air inlet

6 Liquid outlet

7 Suction pipe

8 Protector

9 Relief valve

BEST MODE FOR CARRYING OUT THE INVENTION

The present inventor has been considering methods of reducing pollution caused by fuel oils (WO 98/42807 and U.S. Patent No. 5980700) and further studying to apply the methods widely. As a result, the inventor has found that it is possible to activate not only fuel oils but also other substances by treating the substances in a particular manner and to exert a significant influence on other numerous substances including living bodies with the activated substances, and has provided a method of activating substances and the substances activated by the method (Japanese Patent Application No. 2002-348151 and Japanese Patent Application No. 2002-348152). That is, the present inventor provided a method of activating a substance by heating and pressurizing the substance such as glass or the like in the presence of wood vinegar and/or bamboo vinegar, and the substance activated by the method. After further studies, the present inventor has found that it is possible to activate lower alcohols by using such an activated substance (the

substance activated by such a method will be referred to as a "plough catalyst" hereinafter) and to reduce the amount of hazardous gases in exhaust gas drastically by adding it to a fuel such as gasoline or light oil.

Accordingly, the present invention relates to a method of activating a lower alcohol which comprises bringing the lower alcohol into contact with a substance activated by heating and pressurizing in the presence of wood vinegar and/or bamboo vinegar or with a material formed by processing the substance, and a lower alcohol activated by the method.

The present invention also relates to a fuel additive containing the activated lower alcohol of the present invention and a fuel composition comprising the fuel additive.

The present invention further relates to the use of the substance activated by heating at a particular temperature and pressurizing under a particular pressure in the presence of wood vinegar and/or bamboo vinegar. Hereinafter in the present invention, the substance activated in this manner will be referred to as a "plough catalyst".

Examples of the substances for use in production of such plough catalysts include substances containing silica or the like as the major component such as ceramics, glass and natural stones; inorganic substances such as silicon dioxide; metals such as aluminum, titanium, stainless and iron; noble metals such as gold and silver; organic chemical substances such as resins; and the like.

It is expected that the plough catalyst according to the

present invention provides soils and rivers with self-cleaning capability for recovering the destructed natural environment. Applications of the new plough catalyst include, for example, remediation of acidified soils back to natural soils.

Although the mechanism of how substances are activated by the plough catalyst according to the present invention has not yet to be known, the inventor has completed the present invention, taking into consideration of the function of hydrogen which is a basic component of plants and animals. It is considered that the plough catalyst of the present invention enables to artificially specialize the intramolecular movement of hydrogen atoms and the association of molecules by the method of the present invention. As described, substances in which the movement and the state of elements such as hydrogen atoms in the molecule are specialized by the method of the present invention, are considered to be the "plough catalyst" of the present invention. It is also considered that the substance obtains information about the movement and the state of molecule of the plough catalyst by contacting with the plough catalyst and then the molecular movement of the elements such as hydrogen atom in the substance starts to react normally.

Water is the most abundant in substances on earth and is the substance having the highest proportion in living matter. Water consists of an oxygen atom and two hydrogen atoms, and is normally in a state that a large number of water molecules are bound to each other by hydrogen bonds. The inherent functions and properties of a substance containing water are exhibited

by the normal and active molecular movement of hydrogen atoms of water. However in the world of today, its basic structure has been distorted by various chemicals, and it is believed that the plough catalyst of the present invention plays a role of bringing the distorted structure back to its original natural rhythm.

In addition, genes and proteins have a significant effect on photosynthetic cells of plants and immunological cells of animals. Hydrogen atoms support the structure of genes and proteins, and the three dimensional structure are supported by a large number of hydrogen bonds. The activity normalizing the movement and the state of hydrogen atoms and others in the molecule by the plough catalyst of the present invention maximizes the function above, to exhibit its natural ability inherent thereto, i.e., the power of increasing those essential and protecting from those undesirable for life preservation.

There were so far some discoveries aimed at improving biological functions by using a biological force or the water prepared, for example, by contacting minerals with the water, but the plough catalyst is the first discovery that is made by focusing on the molecular movement of hydrogen.

The experimental effects of the plough catalyst according to the present invention is described below.

A chunk of concrete was produced with an active plough water of the present invention which was produced by using a plough catalyst of the present invention which was made by using glass beads. The chunk of concrete was B4 in size and 12 to 13

cm in thickness. Comparative experiments on rice growth were conducted by using the chunk of concrete (hereinafter, the chunk of concrete is referred to as an eco-board) in thirty-three rice fields throughout Japan. Six eco-boards were placed at even intervals in a rice field of about 1,000 m^2 in area. For comparison, no eco-board was placed in another rice field.

The results are shown in the following Table 1.

Table 1

	Rice field using plough catalyst	Rice field without using plough catalyst
Rice Yields	30-40% increase, compared to rice field using no plough catalyst, at all farmhouses	
Quality of rice (gloss, clearness, etc.)	Graded as "high in high grade" in the criteria of Japan Agricultural Cooperatives, at 95% of farmhouses	
Number of rice tillers	25 to 35 on the average	15 to 20 on the average
Average number of rice grains per ear	98 on the average	75 on the average
Frequency of spraying of agricultural chemicals	None at 20% of farmhouses Once at 80% of farmhouses	3 to 5 times (including spraying immediately before rice planting)
Number of tadpoles	20-30% increase, compared to rice field without using plough catalyst, at all farmhouses	

The reason of the decrease in the frequency of agricultural

chemical spraying is considered that the vital force of rice itself has become powerful and the pest-resistant of rice have been much stronger. The rice plants grown in the field using the plough catalyst had stalks having a diameter about twice larger than that of normal rice. In addition, the number of smaller rice grains decreased to half of that of normal rice. Thus the yield of rice increases by using the plough catalyst according to the present invention; rice per se becomes healthier; and can grow in a natural environment as much as possible.

Further, increase in the numbers of earthworms and dragonflies as well as tadpoles was observed in some of the rice fields. Loose soil of the rice fields using the plough catalyst has changed to more sticky, which shows that the plough catalyst was also effective in improving the soil.

As the results of the component analysis of the rice obtained in these tests, the rice grown in the filed using the plough catalyst was rich in protein components (tasty components) approximately at an average of 8 to 8.5%. The content of protein components of normal rice was approximately 5 to 5.5% on the average. Comparison of these results demonstrated that the rice harvested from the rice field using the plough catalyst of the present invention contains the protein components greater by approximately 60% than that of normal rice. Rice containing too much protein is generally said to harden when it is cooled, but the rice harvested from the rice fields using the plough catalyst shows no deterioration in taste even when it is cooled

and characteristically provides cooked rice that is tasty even when cooled.

Next, tests on the resistance of metals to rust were performed by using a glass beads plough catalyst according to the present invention.

Two transparent plastic containers were prepared; glass beads having a function as the plough catalyst, tap water and a safety pin were placed in one container and only tap water and a safety pin in the other; and both containers are left as tightly sealed. The safety pin placed in the container containing no glass beads plough catalyst of the present invention got rusty soon, but the safety pin in the former container containing the glass beads plough catalyst of the present invention did not get rusty even after 6 months. Although the experiment is continued even now, the pin is still free of rust.

This is presumably because the water is activated by the action of the plough catalyst according to the present invention and makes the metal pin more resistant to rust.

Then, tests on growth of fishes were performed by using the plough catalyst.

A chunk of concrete was produced with an active plough water of the present invention which was produced by using a plough catalyst of the present invention which was made by using glass beads. The concrete was granulated to approximately 1.5 to 2 cm in diameter (eco-marbles). Forty chunks of concrete were added into a water bath where fishes and water plants grew up.

At present, after 4 years from the day when the chunks of concrete were placed in the water bath, the water in the bath has been not caused to rot though it has never been replaced. The test is still continued now. The fishes and water plants are growing healthily. In addition, the feces of the fishes settled down on the bottom of the water bath remain as clots but are not corroded.

Usually when such concrete chunks are placed in a water bath as described above, fishes and plants wither away due to its strong alkalinity of the concrete. It is considered that they stay alive because the plough catalyst has effected on eliminating hazardous substances and transferring the energy necessary for the life support and the growth of plants and animals in the nature.

In addition, a glass filled with tap water was placed on the concrete containing the plough catalyst according to the present invention and then fresh flowers were arranged in the grass. The flowers therein came into blossom much faster than those placed in a glass filled only with tap water. This result is considered that the energy of the plough catalyst of the present invention was transmitted through the glass into the tap water and thereby the blooming was accelerated.

Similarly, growth of foliage plants and garden plants was also activated by use of the plough catalyst according to the present invention.

Further, the taste of tea, coffee and sake with water became milder, by using the water that was previously contacted with

the plough catalyst of the present invention,. Even the tea made from used leaves was more colorful and tastier. Soup stock from dried small fishes was also prepared more easily without foul odor.

Milk which was previously contacted with the plough catalyst of the present invention had a longer expiration period. Further it gradually separated (into water, protein, and fat) and became yogurt state without corruption while it was left to stand. It fitted to eat as a yogurt.

As described above, the plough catalyst according to the present invention has various actions and effects, and shows extremely superior actions and effects in various applications including growth of organisms, preservation of metals, improvement of taste, and preservation of foodstuffs.

In addition to the actions and effects above, the plough catalyst of the present invention has actions such as protecting living body from hazardous electromagnetic waves, increasing negative ions and purifying air.

Hereinafter, the method of producing the plough catalyst according to the present invention is described.

The plough catalyst of the present invention can be produced by heating and pressurizing a substance containing silica or the like as a main component such as ceramics, glass, and natural stones; inorganic substances such as silicon dioxide; metals such as aluminum, titanium, stainless, and iron; noble metals such as gold and silver; chemicals such as organic substances including resins or the like; in the presence of wood

vinegar and/or bamboo vinegar at a particular temperature under a particular pressure.

The wood vinegar for use in production of the plough catalyst of the present invention is a black brown liquid obtained by dry distillation of woods, having irritant odor and containing a great number of components such as esters, lactones, and others. The wood vinegar for use in the method of the present invention is not particularly limited if it is obtained from a wood, but wood vinegars obtained from broadleaf trees, needle-leaved trees, and the like are preferable. Further, the bamboo vinegar for use in the method of the present invention is a liquid obtained by dry distillation of bamboo and may be used in a similar manner to that of the wood vinegar described above.

In the method of the present invention, each of the wood vinegar and the bamboo vinegar may be used alone, but it is preferable to use the wood vinegar and the bamboo vinegar in combination. The blending ratio of the combination is not particularly limited, but preferably the ratio between the wood vinegar and the bamboo vinegar is 1: (0.01 to 10), more preferably 1:(0.1 to 5), and still more preferably 1:(0.1 to 3).

The wood vinegar and/or the bamboo vinegar are used preferably after diluted with water to a concentration normally of approximately 0.0001 to 1%, preferably 0.002 to 0.2%, and more preferably 0.002 to 0.02%.

The amount of the wood vinegar and/or the bamboo vinegar is not particularly limited, but an amount sufficient for immersing the substance to be activated, preferably 1.2 to 5

times, more preferably 1.5 to 3 times that of the substance, is used.

The temperature for producing the plough catalyst of the present invention is preferably at around room temperature, normally approximately at 10 to 80°C, and preferably approximately at 20 to 50°C.

The pressure during production of the plough catalyst of the present invention is 5 to 50 atm, preferably 5 to 10 atm, as gage pressure. An inert gas such as nitrogen may be used as the gas used for pressurization, and air, carbon dioxide, or the like may also be used.

It is also considered that the wood vinegar and/or the bamboo vinegar generate electromagnetic waves inherent to themselves in the manufacturing apparatus by heating and pressurizing the wood vinegar and/or the bamboo vinegar during production of the plough catalyst of the present invention. Presumably, substances are effected electromagnetically by the treatment according to the method of the present invention, and thus, hydrogen atoms, particularly hydrogen atoms involved in hydrogen bonding or the like in the substances are specifically effected and activated, though details such as location of the absorption band of specific electromagnetic waves of the wood vinegar and/or the bamboo vinegar are yet to be known. As described above, the first aspect of the present invention is the use of wood vinegar and/or bamboo vinegar for activating a substance, and the second aspect is to heat and/or pressurize them.

The present invention also provides a method of producing an activated material by using and processing the substance activated in this manner as a raw material, and a substance which is produced by the method. For example, it is possible to activate silicon dioxide which is a raw material for glass, by the method of the present invention described above, and to produce glass by using the activated silicon dioxide obtained thereby. The glass produced in this manner has an action of the activated material of the present invention.

The apparatus for use in producing the plough catalyst of the present invention is not particularly limited, if it is a container that can be pressurized. An example of the apparatus is shown in Figures 1 and 2. Figure 1 is a top view of the manufacturing apparatus, and Figure 2 is a sectional view thereof.

The manufacturing apparatus (1) is almost cylindrical in shape, has a cap (2) on the top and a cap-locking handle (3) for tightly sealing the cap (2) together with an O-ring seal (4), which can be pressurized. The apparatus (1) also has a pressurized air inlet (5), a relief valve (9), and a liquid outlet (6) on the top. A suction pipe (7) is placed inside the apparatus (1). The apparatus (1) is reinforced by a protector (8).

Wood vinegar and/or bamboo vinegar at concentration of 0.002% to 0.02% are placed in the manufacturing apparatus (1);, silicon dioxide which is a raw material of glass is then added as a substance to be activated; and the cap (2) is tightened together with the O ring seal (4). After locking the cap with

the cap-locking handle (3), a pressurized air is supplied through the pressurized air inlet (5) into the container, and the mixture is left at 30°C under 8 atm. After let stand for approximately 48 hours in that state, the silicon dioxide is activated into a raw material for glass having the function of plough catalyst. The activated silicon dioxide is added at a rate of 5 % of the produced glass beads, and thereby all the glass beads turn into the plough catalyst.

Generally, for producing a material by using such an activated substance as a raw material, the raw material is used at a concentration of 0.01 wt% or more, preferably 0.01 wt% to 80 wt%, 0.1% or more, 1 to 80 wt%, more preferably 1 to 50 wt%, 1 to 20 wt%, and 1 to 10 wt%.

The present invention relates to a method of activating a lower alcohol by using the substance activated in this manner (plough catalyst). The activated lower alcohol according to the present invention can be produced by contacting a lower alcohol with the plough catalyst above. For example, it can be produced by placing a lower alcohol and the plough catalyst together in a container such as stock tank. A preferable example of the production method is to circulate a lower alcohol in a container filled with the plough catalyst until the entire lower alcohol becomes sufficiently in contact with the plough catalyst, for example, by using a circulation pump.

In the method of the present invention, the time contacting the plough catalyst with the lower alcohol is not particularly limited, but it is preferable to keep contact with the plough

catalyst during time sufficient for activation of the lower alcohol.

The lower alcohol of the present invention is preferably a straight chain or branched chain aliphatic saturated lower alcohol having 1 to 15 carbons, more preferably 1 to 10 carbons, and still more preferably 1 to 8 carbons. Favorable examples of the lower alcohols include, but are not limited to, alcohols that are liquid at room temperature such as methyl alcohol, ethyl alcohol, n-propyl alcohol, i-propyl alcohol, n-butyl alcohol, i-butyl alcohol, tertiary-butyl alcohol, pentyl alcohol, hexyl alcohol. Ethyl alcohol, i-butyl alcohol, and the like are preferable, in view of safety to human and organisms, and price.

The activated lower alcohol according to the present invention activated by the method above may be used as it is or also used as diluted with the same or different alcohol. The content of the activated alcohol of the present invention produced by the method above is in the range of 0.5% or more, preferably 0.5 to 10 wt%, and 0.5 to 5 wt%. Normally, the activation alcohol is used as diluted to a concentration of 1 to 3 wt% by using the alcohol same as the activated alcohol.

The fuel additive according to the present invention is characterized by containing the lower alcohol activated by the above method or the one or more lower alcohols where the concentration of the activated lower alcohol is diluted to 0.5 to 10 wt%. A lower alcohol containing the activated lower alcohol with a concentration of approximately 0.5 to 3 wt% is preferably used in view of cost, and such concentrations sufficiently show

the advantageous effects of the present invention.

The fuel additive according to the present invention contains the lower alcohol activated by the above method or the one or more lower alcohols where the concentration of the activated lower alcohol is diluted to 0.5 to 10 wt%, in an amount of at least 1 wt% or more, preferably 1 to 100 wt%, 1 to 80 wt%, 3 to 50 wt%, 3 to 40 wt%, or 5 to 40 wt%. The fuel additive according to the present invention may contain fuel components, property improvers of fuels, or the like in addition to the lower alcohols above. Examples include ether compounds such as methyl-tert-butyl-ether; lower alcohol such as butanol and methanol; hydrocarbons such as toluene and benzene; petroleum distillates such as naphtha and petroleum ether; and the like. Further, property improvers such as dehydrating agent and antiknock agent may be also contained.

The present invention provides a fuel composition comprising the fuel additive of the present invention described above. Fuels of the present invention are preferably used for internal-combustion engines of automobiles, ships, airplanes, and the like, and also may be used for boilers and others. Examples of the fuels include gasoline, light oil, heavy oil, and the like.

The fuel composition according to the present invention contains the fuel additives of the present invention above at any rate for the fuel. The blending ratio is not particularly limited, but for example in the range of 5 to 80 wt%, 5 to 70 wt%, preferably 5 to 20 wt%, and normally 5 to 10 wt%.

In addition to a fuel such as gasoline, light oil or heavy oil and to the fuel additive of the present invention, the fuel composition of the present invention may additionally contain other fuel components. Other examples of the fuel components include ether compounds such as methyl-tert-butyl-ether; lower alcohol such as butanol and methanol; hydrocarbons such as toluene and benzene; petroleum distillates such as naphtha and petroleum ether; and the like.

The fuel additive according to the present invention contains lower alcohols as main components, and fuel such as gasoline, light oil, heavy oil, or the like are mostly hydrocarbons. Generally, a mixture of them containing the lower alcohols at a higher concentration may cause phase separation, but the fuel additive of the present invention can be stably stored over a long term by using a lower alcohol of the present invention even when the concentration of the lower alcohols is 70 wt%. For example, a fuel composition containing;

-ethanol comprising the activated ethanol of the present invention at 1 wt%: 65 wt%,

-butanol: 5 wt%, and

-gasoline: 30 wt%

has not shown phase separation even though it has been stored at room temperature for four years. In addition, phase separation was not found when it was cooled at -20°C for 24 hours.

Thus, it is one of the distinct characteristics of the present invention to provide a stabilized fuel composition.

Further, fuels added the fuel composition or the fuel

additives of the present invention can inhibit the emission of hazardous components from the exhaust gas. For example, a fuel additive of the present invention having the following composition was produced and the performance thereof was tested.

Fuel additive (plough FA):

-Isobutanol comprising activated isobutanol at 1 wt%: 5 wt%,

-Ethanol: 65 wt%

-Naphtha raffinate: 30 wt%

Performance tests were conducted by using gasoline containing the fuel additive (plough FA) at 7 wt% and a control gasoline containing no additive with type E-GX-110 engine (Toyota) at the 10-15 mode. Results are shown in the following Table 2.

Table 2

Gasoline 10-15 mode

	CO(g/km)	HC(g/km)	NO_x(g/km)	CO_2(g/km)	Gas mileage (km/L)
Before addition	0.80	0.10	0.12	231	10.2
After addition	0.41	0.04	0.13	232	10.2

As the results, though the gas mileages were the same at 10.2 km/L, the emission of the carbon monoxide (CO) from the additive-free gasoline was 0.80 g/km, on the other hand, that

from the gasoline containing the fuel additive of the present invention was 0.41 g/km, almost half. The emission of the hydrocarbon (HC) from the additive-free gasoline was 0.10 g/km, on the other hand, that from the gasoline added the fuel additive of the present invention was 0.04 g/km, almost half. There was no significant difference regarding the emission of nitrous oxide (NOx) and carbon dioxide (CO_2).

The gasoline containing the fuel additive of the present invention comprises lower alcohols at approximately 5 wt% in total. Significant change was seldom seen in the components of exhaust gas at such a content of the lower alcohols, and therefore it is considered that the results show the advantageous effects of the activated lower alcohol by the method of the present invention. That is, it becomes possible to reduce the amounts of carbon monoxide and hydrocarbons in the exhaust gas to half without affecting the gas mileage of fuel, by using the fuel additive according to the present invention.

The effects of the lower alcohols activated by the plough catalyst of the present invention are excellent as described above. It is presumed that the lower alcohols having hydrogen atoms which may be susceptible to the plough catalyst are activated by the plough catalyst and that the components of the activated lower alcohols make a certain action on fuel combustion, though details of the action mechanism are not completely understood. It is considered that hydrogen atoms of the hydroxyl group in the activated lower alcohol lead to more complete combustion by interaction with the hydrogen atoms of fuel

hydrocarbons, the oxygen atoms in air, and the like. As the result, presumably, the amounts of carbon monoxide and hydrocarbons which are residues of imperfection combustion in the exhaust gas, have decreased.

All of the description in Japanese Patent Application No. 2002-379885 is also included in the present specification.

Examples

Hereinafter, the present invention is described more specifically with Reference Examples and Examples, but it should be understood that the present invention is not limited to these Examples.

Reference Example 1

Production of plough catalyst comprising glass product

(1) Activation of silicon dioxide

Silicon dioxide as raw material for glass was activated into a plough catalyst by using the apparatus (1) as shown in Figures 1 and 2.

Solution of 10 L of tap water containing a liquid mixture of wood vinegar and bamboo vinegar at a concentration of 0.05% was placed in the apparatus (1), and 10 kg of silicon dioxide as a glass material was added thereto; after tightening the cap 2, a pressurized air was introduced so that the pressure inside of the apparatus be 8 atm.

The mixture was left at 30°C for 48 hours in the same

condition, and the activated silicon dioxide was taken out of the apparatus (1).

(2) Production of plough catalysts comprising glass marbles and glass beads

Plough catalysts comprising glass marbles and glass beads were produced by preparing the silicon dioxide activated in Example 1 where the silicon dioxide was adjusted to 5 % of the glass beads to be produced in producing glass marbles and glass beads.

Example 1

Production of isobutanol activated by plough catalyst

400 g of the plough catalysts comprising glass marbles and glass beads produced in Reference Example 1 were filled into a container having a capacity of 600 ml, and 100 L of isobutanol which was stored in a 550-L stock tank was circulated in the container at a flow rate of 10 L/min for 48 hours, to produce 100 L of activated isobutanol.

Example 2

Production of ethanol activated by plough catalyst

400 g of the plough catalysts comprising glass marbles and glass beads produced in Reference Example 1 were filled into a container having a capacity of 600 ml, and 100 L of ethanol which was stored in a 550-L stock tank was circulated in the container at a flow rate of 10 L/min for 48 hours, to produce 100 L of activated ethanol.

Example 3

Production of isobutanol containing the activated isobutanol

0.1 L of the isobutanol produced by the method described in Example 1 was added to 9.9 L of isobutanol, and the mixture was stirred well, to produce 10 L of activation isobutanol of the present invention containing activated isobutanol at 1 wt%.

Example 4

Production of ethanol containing activated ethanol

0.1 L of the ethanol produced by the method described in Example 2 was added to 9.9 L of ethanol, and the mixture was stirred well, to produce 10 L of activation ethanol of the present invention containing activated ethanol at 1 wt%.

Example 5

Production of fuel additive, plough FA

500 g of the isobutanol containing activated isobutanol 1 wt% which was produced in Example 3 (specific gravity: 0.802), 650 g of ethanol (specific gravity: 0.816), and 300 g of naphtha raffinate (specific gravity: 0.7307) were mixed and stirred, to produce 1,000 g of fuel additive, plough FA.

Example 6

Production of fuel additive B

50 g of the isobutanol containing the activated isobutanol at 1 wt% which was produced in Example 3 (specific gravity, 0.802),

410 g of methanol, 50 g of methyl-tert-butyl-ether, 100 g of toluene, and 390 g of naphtha were mixed, and to produce fuel additive B.

Example 7

Production of gasoline fuel composition

The fuel additive plough FA which was produced in Example 5 was added to regular gasoline to approximately 7 wt%, to produce gasoline fuel composition of the present invention.

Example 8

Production of gasoline fuel composition

A mixture of 6,500 g of the activation ethanol of the present invention containing of the activated ethanol at 1 wt% which was produced in Example 4 and 500 g of butanol was added to 3,000 g of gasoline, to produce a gasoline fuel composition.

The gasoline fuel composition has not exhibited phase separation though it has been stored at room temperature for four years. In addition, phase separation was never caused even when it was cooled at -20°C for 24 hours.

Test Example 1

Exhaust gas and gas mileage tests were conducted by using the gasoline fuel composition which was produced in Example 7 and regular gasoline at Tokyo Metropolitan Research Institute for Environmental Protection.

Automobile used: type E-GX100 (Toyota)

Engine displacement: 1988cc

Compression ratio: 9.6

Maximum power: 140 ps /5,600 rpm

Test condition: 10-15 mode

Laboratory temperature: 22.2°C

Laboratory relative humidity: 55.2%

Laboratory atmosphere pressure: 759.0mmHg

Test apparatus: Small chassis dynamometer (Hitachi)

Exhaust gas analyzers: MEXA-9200 and MEXA-9500G (Horiba)

CVS apparatus (CFV): CVS-9200 (Horiba)

(1) Results of the tests using regular gasoline

First, tests were conducted by using regular gasoline under the following condition.

Amount of gas sampling: 6.084 m^3/min

Amount of Diluted exhaust gas: 66.928 m^3

Dilution rate: 16.014

The gas mileage by carbon balance was 10.23 km/L. Results of the analysis of the exhaust gas are shown in the following Table 3.

Table 3

Exhaust gas component	Diluted exhaust gas concentration A	Diluted air concentration B	Net concentration A-{B*(1-1/DF)}	Emission
CO(NDIR)	43.07 ppm	0.2 ppm	42.86 ppm	0.80g/km
HC(FID)	13.19 ppm	2.40 ppmC	10.93 ppmC	0.10g/km
NO_X(CLD)	4.19 ppm	0.03 ppm	4.16 ppm	0.121g/km
CO_2(NDIR)	0.831 %	0.047 %	0.787 %	230.9g/km

(Note)

(1) NDIR: non-dispersive infrared analyzer

(2) FID: hydrogen flame ionization detector

(3) CLD: chemiluminescent analyzer

(2) Results of the tests using the gasoline fuel composition produced in Example 7

Then, the tests were conducted by using the gasoline fuel composition which was produced in Example 7, under the following condition:

Amount of gas sampling: 6.065 m^3/min

Amount of Diluted exhaust gas: 66.710 m^3

Dilution rate: 15.924

The gas mileage by carbon balance was 10.22 km/L. Results of the analysis of the exhaust gas are shown in the following Table 4.

Table 4

Exhaust gas component	Diluted exhaust gas concentration A	Diluted air concentration B	Net concentration A-{B*(1-1/DF)}	Emission
CO(NDIR)	22.61 ppm	0.57 ppm	22.07 ppm	0.41g/km
HC(FID)	5.84 ppm	2.11 ppmC	3.87 ppmC	0.04g/km
NO_X(CLD)	4.55 ppm	0.05 ppm	4.50 ppm	0.130g/km
CO_2(NDIR)	0.839 %	0.043 %	0.798 %	232.1g/km

(Note)

(1) NDIR: non-dispersive infrared analyzer

(2) FID: hydrogen flame ionization detector

(3) CLD: chemiluminescent analyzer

INDUSTRIAL APPLICABILITY

The present invention provides a lower alcohol which is activated by plough catalyst, a fuel additive and a fuel composition using the same. A fuel prepared by using the fuel additive and the fuel composition according to the present invention can drastically decrease the hazardous components in the exhaust gas and prevent air pollution caused by internal-combustion or the like, without degrading the performance of conventional fuel such as gas mileage, and thus provide the fuel composition which is good for the environment. In addition, the fuel additive according to the present invention can be mixed with relatively high concentration of fuel, and is stable for a long period after mixing, to provide the fuel

composition reducing the amount of fossil fuel to be used, which is good for the environment.